Garnet Phosphors Prepared by a Precipitation Technique

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Garnet phosphors, especially cerium-activated $Y_3Al_5O_{12}$, are key components in white light emitting diodes (LEDs) for converting the blue emission of GaN-based LEDs to a longer wavelength. These phosphors show high quantum efficiencies as well as efficient blue absorption. Moreover, spectral emission characteristics can be tailored by modifying both host lattice and dopant composition. In addition to the luminescence properties, particle size and morphology of the garnet powder play an important role with regard to resin incorporation and optical behavior. Powders are fabricated by a high-temperature solid state reaction of the base oxides followed by intensive milling to adjust the desired particle size distribution. Utilizing advanced precipitation techniques, the particle characteristics can be adapted by the precipitation conditions. Thus, the drawbacks and limitations of milling can be overcome. For that reason, a basic feasibility study has been performed on the precipitation of mixed hydroxides from homogeneous aqueous solutions and a subsequent low-temperature calcination for garnet formation. Phase-pure phosphor powders are achieved by the precise control of the composition of the stock solutions and by the calcination above 1100 °C. A typical excitation and emission spectrum of a precipitation-derived YAG:Ce powder is illustrated in Fig. 1, indicating the presence of the well-known Ce^{3+} transitions. The influence of the synthesis parameters on the luminescence properties and the particle characteristics of such garnet phosphors will be discussed.

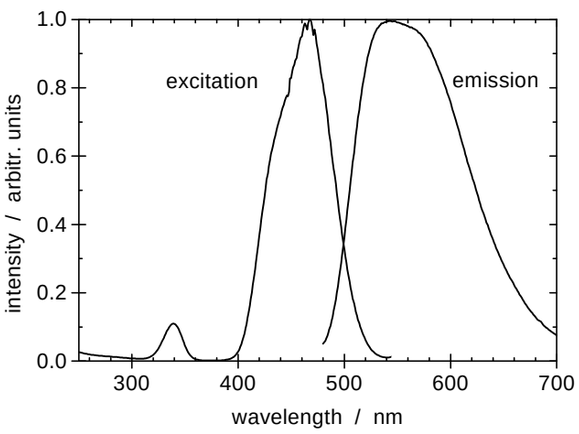

Figure 1: Excitation and emission spectra (emission measured at 470 nm excitation) of a cerium-activated $Y_3Al_5O_{12}$ prepared by a hydroxide precipitation